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DIVISION OF ENTOMOLOGY—BULLETIN NO. 34, NEW SERIES.

L. O. HOWARD, Entomologist.

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U. S. Department of Agriculture,
Washington, D. C.

PRINCIPAL INSECTS LIABLE TO BE DISTRIBUTED ON NURSERY STOCK.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST,

BY

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Assistant Entomologist.

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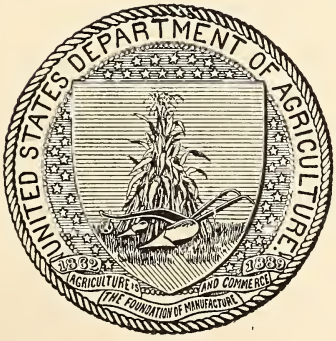

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Entomology,
Washington, D. C., April 29, 1902.

Sir: I have the honor to transmit for publication a manuscript prepared by Mr. Nathan Banks, of this office, in which are considered the principal insects liable to be distributed upon nursery stock. The inspection of nursery stock under State laws has become so general throughout the United States that the desirability of some publication of this sort has become very evident. I had the matter in mind last autumn, and at a conference of the official horticultural inspectors for the United States, held at Washington October 11–13, 1901, a resolution was unanimously passed requesting this Department to prepare and publish an article on those nursery pests of the country which are capable of transmission on nursery stock to the injury of the purchasers. Since it is desirable that this manuscript shall be put in available shape for distribution to all horticultural inspectors and to all nurserymen and others immediately interested, I recommend that it be issued as Bulletin No. 34, new series, of this Division.

Respectfully,

L. O. Howard,
Entomologist.

Hon. James Wilson,
Secretary of Agriculture.

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THE PRINCIPAL INSECTS LIABLE TO BE DISTRIBUTED ON NURSERY STOCK.

INTRODUCTION.

In preparing this descriptive catalogue of the insects liable to be transported upon nursery stock, it has appeared that there is a great disparity of views as to what insects should be included. To include only such as are known to be very destructive would exclude a great many species that will be found by anyone who examines a tree in the fall or early spring. To include all the species that are known to be found in any stage upon fruit trees in winter would make the list too bulky. Therefore, all species known to be of more than local interest have been treated. Notes on the species infesting fruits are added at the end. The insects have been arranged according to their natural orders, and in the Hemiptera (bugs, scale insects, plant-lice) according to the families. In the Coleoptera (beetles, weevils) and Lepidoptera (butterflies and moths), such an arrangement did not seem desirable. No account of the remedies to be recommended or used is given, as these differ greatly, according to locality and conditions, and the various State laws specify certain treatments.

It will be a great help to those interested in the growth and sale of young fruit trees to be able to recognize the appearance of the various insect pests during the winter; therefore, much attention has been paid to this phase of the subject.

In using this bulletin one should remember that, besides the insects here treated, there may be upon a tree other insects of less importance.

TABULAR STATEMENT OF INSECTS UPON THE TREE IN WINTER.

Insects upon the roots:
- Forming swellings on apple roots ..... Woolly aphis.
- On peach and plum roots ..... Black peach aphis.

Insects upon the bark of trunk or branches:
- Plant-lice or aphids ..... Woolly aphis.
- Small brown clear-winged insect in the crevices of bark ..... Pear psylla.
- Scale insects or bark-lice ..... See Coccidæ.
- Caterpillars in cases or cocoons ..... Fall webworm, bud moth, apple Bucculatrix, codling moth, pistol-case and cigar-case bearers.
- In nests or bunches of shriveled leaves attached to branches ..... Leaf-crumpler, and brown-tail moth.

Insects upon the bark of trunk or branches—Continued.
- In a case or bag hanging from twigs ..... Bagworm.
- Clusters of eggs on bark ..... Cankerworms, tussock moth, and gipsy moth.
- A belt of eggs around twigs ..... Apple-tree tent caterpillar.
- Single small blackish eggs often in groups on twigs or branches ..... Plant-lice.
- Smaller reddish eggs ..... Clover mite.

Insects beneath the bark:
- Tiny holes usually near a crotch, each covered by a bit of frass ..... Peach twig-borer.
- Small brown beetle within the twig ..... Apple twig-borer.
- Small holes in bark of trunk or larger branches ..... Fruit-tree bark-beetle.
- A gummy exudation of sap at base of tree ..... Peach tree-borer.
- Discolored spots or cracks and evidences of frass ..... Round-headed and flat-headed apple tree-borers, and sinuate pear borer.

TABULAR STATEMENT OF INSECTS FEEDING ON THE BUDS AND YOUNG LEAVES IN EARLY SPRING.

Feeding on the buds or young shoots .... Bud worm, peach twig-borer, leaf-crumpler, brown-tail moth, pistol-case and cigar-case bearers.

Feeding upon the leaves:
- Plant-lice ..... Apple plant-lice, plum plant-louse, and cherry aphis.
- Caterpillars in tents ..... Apple-tree tent caterpillar.
- Hairy caterpillars ..... Tussock moth, brown-tail moth, gipsy moth.
- Bare caterpillars ..... Canker worms.
- A blister or gall upon leaves ..... Pear-leaf blister-mite.
- Small caterpillars within little cases ..... Pistol-case bearer, cigar-case bearer, leaf-crumpler, and bagworm.

HEMIPTERA (BUGS, SCALE INSECTS, AND PLANT-LICE).

The members of this order obtain their food (which is liquid) by sucking it up a slender tube into the mouth cavity. This tube or beak is composed of several needle-like pieces so shaped and arranged that they inclose a minute channel up which the liquid food is drawn. The beak is inserted in the plant often to some distance beneath the surface. The members of this order do not pass through a pupal or chrysalis stage like the butterflies and moths, but there is an approach to it in the males of the scale insects. The insects of this order to be treated are arranged in four families, which may be separated, for our purposes, as follows:

The insect from above apparently without legs, antennæ, or wings, and fixed to the host plant; the adult male (not often seen) usually has two wings ..... Coccidæ. (scale insects).

The insect shows distinct legs and antennæ, and often four wings.
- Most of the specimens wingless, and provided with two small tubes or cornicles (see fig. 16) near tip of body; not hopping when disturbed ..... Aphididæ (plant-lice).
- Adult always winged, without the cornicles; hopping when disturbed.
  - The prothorax not enlarged, with hyaline wings ..... Psyllidæ.
  - The prothorax greatly enlarged; wings obscured ..... Membracidæ.

FAMILY COCCIDÆ (SCALE INSECTS).

The scale insects, or bark-lice, are readily known from most insects in that the stages commonly seen are immovably fixed to the bark or leaf, and show no outward sign of legs or other structures. For a short time after birth they are active, crawling creatures, and distribute themselves over the surface of the plant. Having selected a location, they push their long and thread-like beaks deep into the tree and proceed to suck up the sap. As they grow the protected or covered bark-lice secrete a waxy substance that hardens and forms the scale. When the insect molts the old skin or exuvium remains attached to the scale. The shape, color, and position of this exuvium is of great value in identifying the species.

Their small size and similarity of appearance makes their determination difficult, and it is rarely safe to determine the species by a few individuals, but on a moderately infested branch one is apt to find some specimens that are quite characteristic of the species.

The unprotected bark-lice, such as the Lecaniums, secrete no covering scale.

TABLE OF SCALE INSECTS.

1. Soft scales, without a shield-like covering, very convex, on peach or plum. *Lecanium nigrofasciatum.*
2. Armored scales, with a shield-like covering and showing an exuvial spot, much less convex than Lecanium ..... 3.
3. The exuvium shows as a circular spot situated near the center or at least remote from the edge of the scale; the adult female scale more or less circular, rarely whitish in color ..... *Aspidiotus.*
4. The exuvium showing as a more or less ribbed, elliptical spot at the end or close to one edge of the scale; scales usually whitish in color; if not, then of an oyster-shell shape ..... 5.
5. Scale brownish; the female of an oyster-shell shape, male ovate. *Mytilaspis pomorum.*
6. The scale whitish, female not oyster-shell shaped, male scale elongate ..... 7.
7. The female scale plainly ovate, much longer than broad; the male scale having three longitudinal keels (see fig. 4, *d*) ..... *Chionaspis furfurus.*
8. The female scale is irregularly circular, but little longer than broad; the male scale with one median keel ..... 9.
9. Exuvium orange or bright yellowish; on fruit trees; male with keel rather indistinct ..... *Diaspis pentagona.*
10. Exuvium pale or dull yellowish; on raspberry and blackberry; male with distinct keel ..... *Aulacaspis rosæ.*

THE PEACH LECANIUM.

(*Lecanium nigrofasciatum* Perg.— fig. 1.)

This insect, formerly known as *L. persicae*, is one of the largest of the scale insects, being about one-fifth of an inch long and two thirds as wide. It is elliptical in outline and strongly convex. It is usually of a dull greenish-brown color, sometimes distinctly marked with darker

bands. It is found upon the branches of peach and plum, more rarely on apple, and commonly occurs on the under side of the branch, the upper side of which is covered with a black fungus that grows on the honey-dew dropped by the Lecaniums from the branch above. The females pass the winter in the adult condition. The eggs are developed by the latter part of May. The young hatch early in June and continue for fully a month (June 10 to July 15). The young larvæ are flat, uniformly pale yellow, and with a thin marginal rim. They become stationary in a few weeks. By the middle of July the male pupæ are developed, and by the 22d the first winged males appear. There is but one brood a year, and the best time for treatment will be during July.

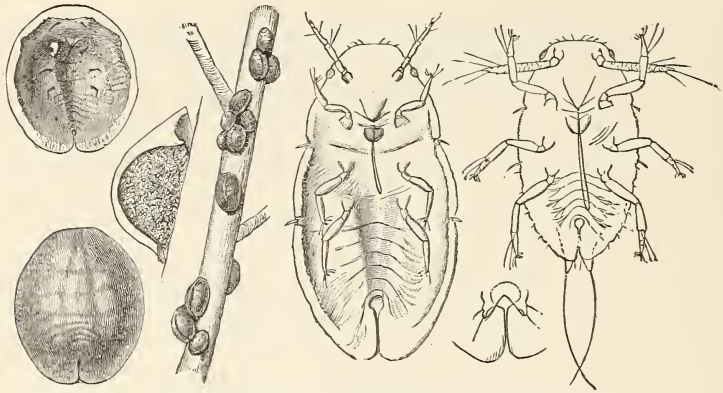

FIG. 1.—*Lecanium nigrofasciatum* Perg.: adults at left, young at right. (Howard).

There is another species of Lecanium (*L. prunastri*), less commonly found on plum. The female is much like that of the peach Lecanium, but the insect passes the winter in the larval state, not maturing till May. The young hatch in July, migrate to the leaves, and in the early fall return to the branches, where they pass the winter. It has rarely been found in this country outside of New York State.

THE OYSTER-SHELL BARK-LOUSE.

(*Mytilaspis pomorum* Linn.—figs. 2 and 3.)

The oyster-shell bark-louse is one of the best known enemies of the orchardist. It is a dark, slightly convex scale, elongate and usually curved in outline, much resembling a miniature oyster shell. When crowded upon the tree they are apt to be less curved and often quite straight. The elongate exuvium is situated at the small end. Its elongate shape and dark color at once separate it from all other common orchard scales. The eggs, which are whitish in color, are deposited in late summer, and occupy the posterior two-thirds of the scale. The female dies, but the scale remains to protect the eggs during the winter. The young hatch in May or early June, crawl out upon the

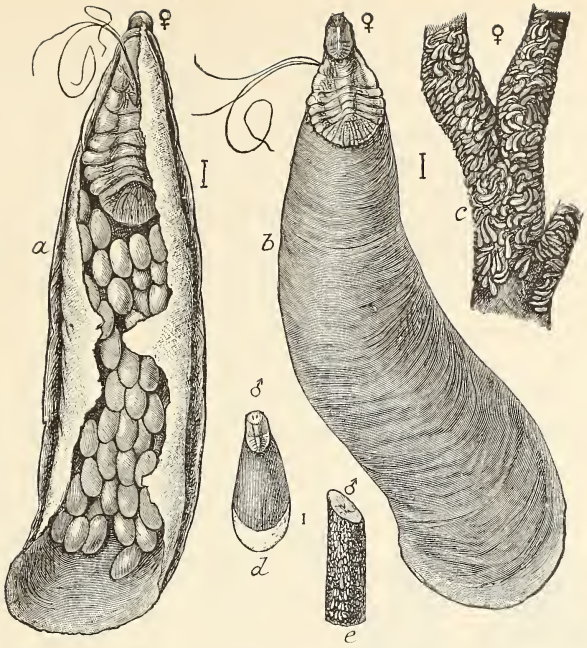

FIG. 2.—*Mytilaspis pomorum: a, b*, females; *c*, scales on twig; *d*, male scale. (Howard.)

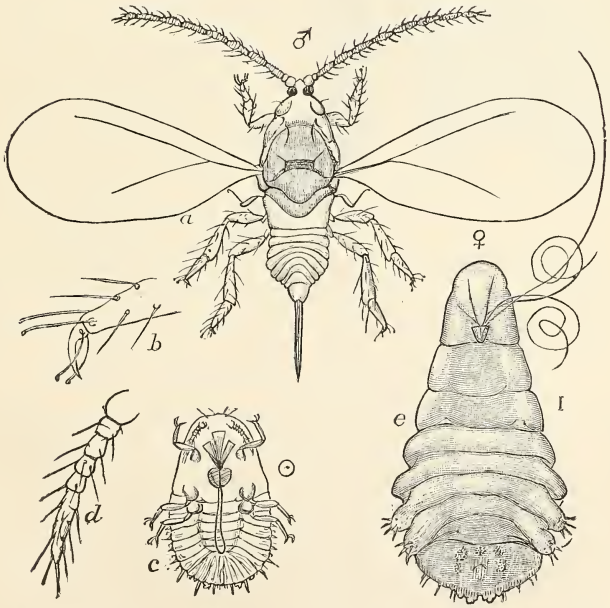

FIG. 3.—*Mytilaspis pomorum: a*, male; *c*, larva; *e*, female; *b* and *d*, details. (Howard.)

twigs and small branches, and locate there permanently. In a day or two they begin the formation of the scale. The male scale is much smaller than the female, elongate, wider behind than in front, and little, if any, curved. It is uncommon on apple, but often found on other food plants. The winged male insect appears in midsummer. There is but one brood a year in the North, but in parts of the South there are apparently two broods; the second one hatching about September 1. The oyster-shell bark-louse is widely distributed and attacks a great variety of trees, but is especially partial to apple.

THE SCURFY BARK-LOUSE.

(*Chionaspis furfurus* Fitch—fig. 4.)

This common orchard scale is readily known by its whitish color and ovate form. The adult female scale is rather flat, irregularly ovate in outline, with the yellowish exuvium at the apex. The life history is similar to that of the oyster-shell bark-louse. The eggs are laid in the early fall and occupy the greater part of the scale. The mother dies and the scale remains on the tree during the winter to protect the eggs. The young hatch during the latter part of May or early in June. The male scale, which is often very abundant, is much smaller than the female, snow-white in color, and fully twice as long as broad, with nearly parallel sides and three keels or ridges. The winged male insects issue in September. There is but one brood in the North, but probably two or even three in the South. The scurfy bark-louse is widely distributed and occurs on most orchard trees, but chiefly on apple and pear.

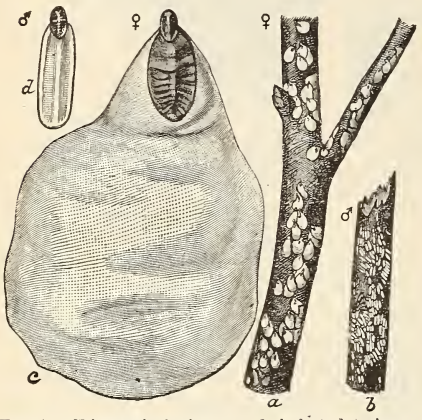

FIG. 4.—*Chionaspis furfurus: a, b*, infested twigs; *c*, female; *d*, male. (Howard.)

ASPIDIOTUS (CIRCULAR OR ROUND SCALES).

To this genus belongs the most destructive known species, the San Jose scale. The other species, however, often cause much damage. There is a considerable resemblance among the various species, so that it is difficult for any inexperienced person to determine them. The final characters that separate species are based on the structure of the pygidial plate of the adult female scale. To observe this it is necessary that a specimen be boiled in caustic potash and mounted in balsam on a glass slide. When this is examined under a microscope the lobes, spines, hairs, and sinuations of the margin of the plate

appear quite distinctly. Thus, the characters that may be used in the field are not final and only comparative, and great care must be exercised, especially when only a small amount of material is available, and any doubt can be settled only by sending the material to some competent authority who can mount and microscopically examine the species.

TABLE OF ASPIDIOTUS.

1. Scale of adult female circular, with exuvium central, dark-colored, the exuvium pale yellowish when dark waxy outer covering is rubbed off; scale not very convex, about 2mm in diameter; half-grown scales are nearly black and show a central nipple surrounded by one or two depressed rings.....*perniciosus* Comst.
   Scale of adult female not circular, the exuvial spot at one side of the center; the half-grown scales usually paler and without the central nipple surrounded by depressed ring.....2.
2. Adult female scale dark-colored, about 2mm in diameter; exuvial spot orange or reddish colored.....*A. forbesi, ancylus,* and *ostreæformis.*
   Adult female scale paler, or larger, or with white center.....3.
3. Scale of adult female about 2mm in diameter, yellowish or pale brownish, with a white center, quite flat; on grape.....*uvæ* Comst.
   Scale of the adult female very convex, about 2½mm in diameter, of a uniform drab or yellowish-brown color, the exuvial spot showing reddish, but not commonly exposed.....*rapax* Comst.
   Scale of the adult female large, nearly 3mm in diameter, flat, and pale-grayish in color; the exuvium reddish or orange.....*juglans-regiæ* Comst.

In identifying scale insects by means of the above table, scales should be examined from bark or fruit as clean as possible, and where the scales are not crowded and have room to normally develop. When thickly massed they lose their characteristic shape and appearance, and on sooty or dirty bark they are discolored and abnormal.

THE SAN JOSE SCALE.

(*Aspidiotus perniciosus* Comstock—figs. 5, 6, and 7.)

The San Jose scale is known to every orchardist by hearsay, but few, however, can distinguish it from allied scales, such as *ancylus*, *forbesi*, and *ostreæformis*. On badly infested trees the scale presents the appearance of dark gray, scurfy patches. The individual scale is about 2mm in diameter, usually nearly circular in outline, of a grayish color, with the central darker nipple surrounded by one or more quite distinct yellowish or pale grayish rings. When the scales are crowded the outline is more or less distorted. In none of the allied forms is the adult female scale as nearly circular as in the San Jose scale. When on fruit or young twigs there is often a reddish discoloration around the scale. Putnam's scale and the cherry scale have a brighter colored exuvium, situate one side of the center. The cherry scale is often much paler than the San Jose scale. The European fruit scale has an exuvium similar to the San Jose, but lacks the darker nipple;

moreover, the exuvium is plainly not at the center of the scale. The male of the San Jose scale is about two times as long as broad; broader at one end than at the other, with a large, dark exuvium, showing a central nipple. It is situated toward the small end of the scale. The male of the European fruit scale is not so elongate, and the exuvium is but little darker than the scale and nearer to the small end than in the San Jose scale. The male of Putnam's scale is as elongate as that of San Jose, but has an orange exuvium. The male of the cherry scale is in shape much like that of the San Jose scale, but the exuvium is of a brighter yellow, the scale usually being paler than the San Jose.

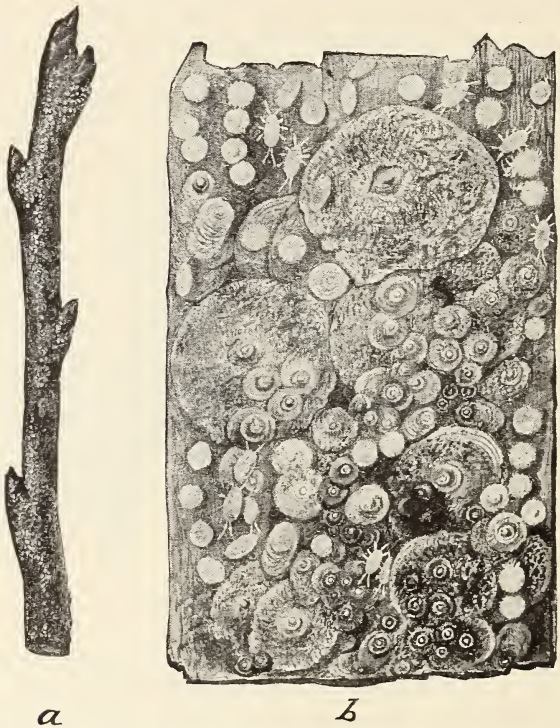

FIG. 5.—*Aspidiotus perniciosus: a*, infested twig; *b*, view of infested bark magnified. (Howard and Marlatt.)

In general the adult female of the San Jose scale may be distinguished from its allies by the more circular scale, with yellow exuvium, when exposed, more centrally located, otherwise with dark nipple; the male by similar characteristics of exuvium and nipple. But the San Jose scale is most easily recognized by its immature scales, which are almost black, circular, and with a central nipple surrounded by one or two depressed circular rings. Such a character is not found in any other of the allied scales.

The San Jose scale attacks all of our orchard trees, but appears to be most destructive to pear and peach. The insect is represented in winter by partly grown specimens whose development was stopped by the cold weather. They resume growth in the early spring; the males soon appear, mate with the females, and the latter give birth to living young. At Washington, D. C., this time is about the middle of May, and the young continue to appear for about six weeks. The larva crawls off a little way, settles, and within two days begins the

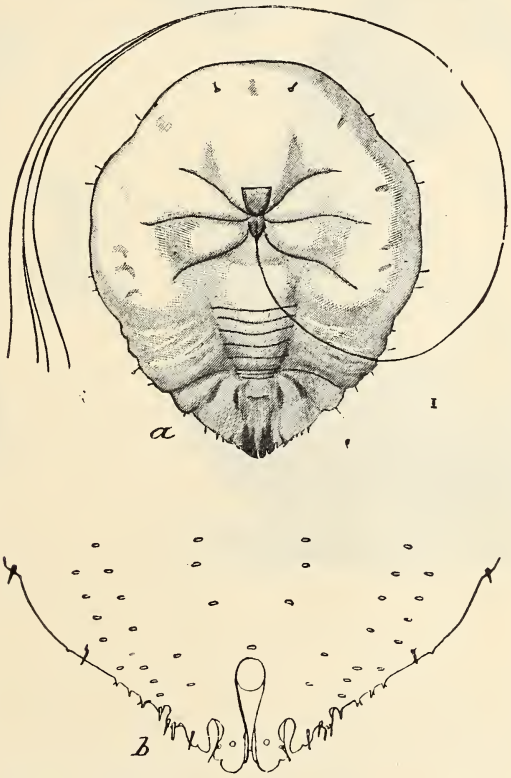

FIG. 6.—*Aspidiotus perniciosus: a*, female; *b*, margin of pygidium magnified. (Howard and Marlatt.)

secretion of its scale. This young scale is at first white with a swelling in the center. If it is situated on green tissue it is apt to produce a redness. In a few days the pale scale becomes nearly black, with a central nipple surrounded by one or two depressed rings. This form is very characteristic of the species. In about twenty-five days another brood of males appears, and in thirty days the females become adult. At about thirty-five or forty days of age the females begin to give birth to living young. Since one of these mother scales may have been born six weeks before another, it results that there is a

confusion of generations throughout the summer, breeding constantly going on until late fall. The number of broods will thus depend upon the length of the season.

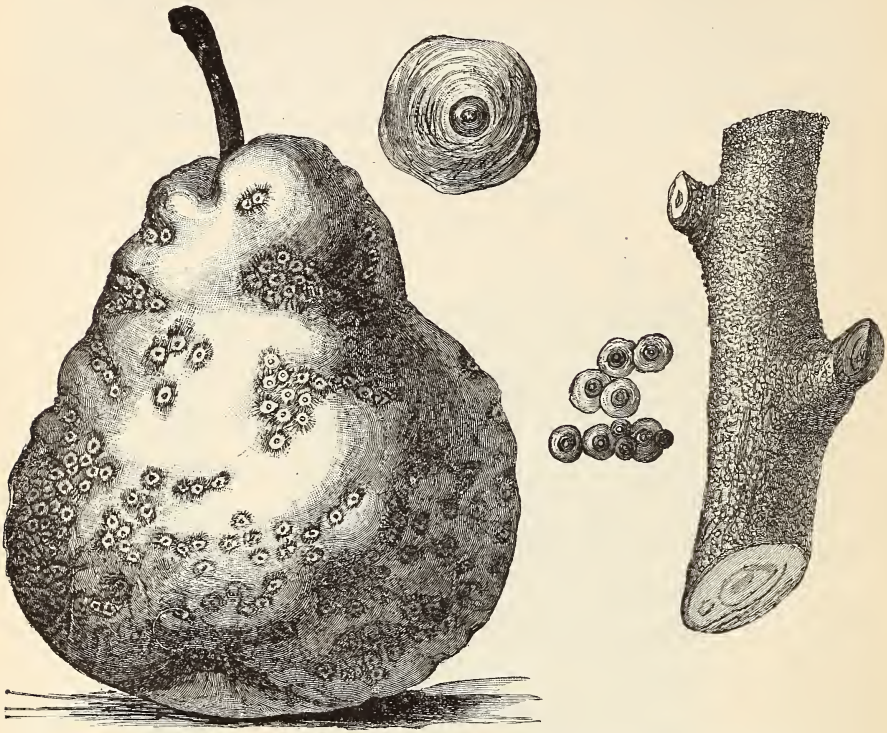

FIG. 7.—*Aspidiotus perniciosus:* Infested fruit and branch, and enlarged scales. (Howard.)

THE EUROPEAN FRUIT SCALE.

(*Aspidiotus ostreæformis* Curtis—fig. 8.)

This species can usually be readily separated from the San Jose scale by the characters mentioned under that species, but it is practically impossible, without making a microscopic mount, to distinguish it from Putnam's scale and the cherry scale. The cherry scale, especially when on cherry, is more shining and often shows a grayish margin. The European fruit scale occurs on all orchard trees, but only, so far as known, in certain Northern States. The winter is passed by the partly grown specimens, which become mature toward the last of June, and soon begin to give birth to living young. The young continue to appear for several weeks. There appears to be but one brood a year, at least in the Northern States.

PUTNAM'S SCALE.

(*Aspidiotus ancylus* Putnam.)

This scale is widely distributed and attacks all orchard trees. In general appearance it is like the San Jose scale, but at once known by the exposed orange exuvium, the less circular scale, and by the half-grown young having no depressed ring around the nipple. It can be separated from the European fruit scale and from the cherry scale only by a microscopic examination of mounted specimens. It is usually much darker than the cherry scale, the exuvium usually a brighter orange, and the scale more conical than that species. Specimens vary, however, a great deal in these points. The insect winters in a nearly full-grown condition. The males appear in April, soon pair with the females, and the latter deposit eggs in the late spring or early summer. The young begin to hatch early in July and continue during the month. There is but one brood a year.

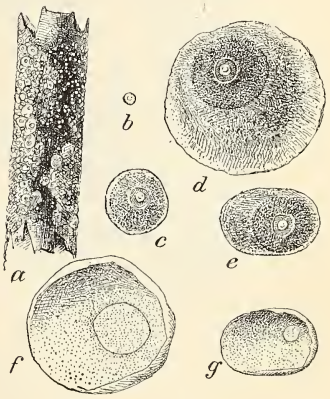

FIG. 8.—*Aspidiotus ostreæformis: a*, scales on twig; *b*, natural size; *c*, immature stage; *d*, female; *e*, male; *f* and *g*, inside of scales. (Marlatt.)

THE CHERRY SCALE.

(*Aspidiotus forbesi* Johnson.)

This scale is similar to Putnam's and to the European fruit scale, but sometimes, especially on cherry, it is more shining, and presents a gray rim around the scale, which is commonly flatter than the allied species. It attacks all orchard trees, but is rarely common. It winters partly grown, like its allies. The male issues in April. The eggs are laid in April or early May, the young hatching during May and part of June. There appears to be two broods a year, the males of the second brood issuing during the latter part of July and the young during August and September.

THE WALNUT SCALE.

(*Aspidiotus juglans-regiæ* Comstock—fig. 9.)

This insect is at once recognized by the large size of the adult female scale, it being the largest of our species of the genus, the scale often being 3^{mm} in diameter (one-twelfth inch), while the San Jose scale is scarcely 2^{mm} in diameter. The adult female scale is irregularly circular in outline, quite flat, and of a pale grayish or dirty-white color. The exuvial spot is reddish or orange and situated one side of the center. The scale often appears to be less closely attached to the bark than with the other species of this genus. The male scale is elliptical

and much smaller than the female. The adult female scale hibernates, and deposits eggs in early spring. The males from them issue early in June. Eggs are deposited again in June, so that there appears to be two or possibly three broods in the South. This species is not abundant, but liable to be found on almost any orchard tree.

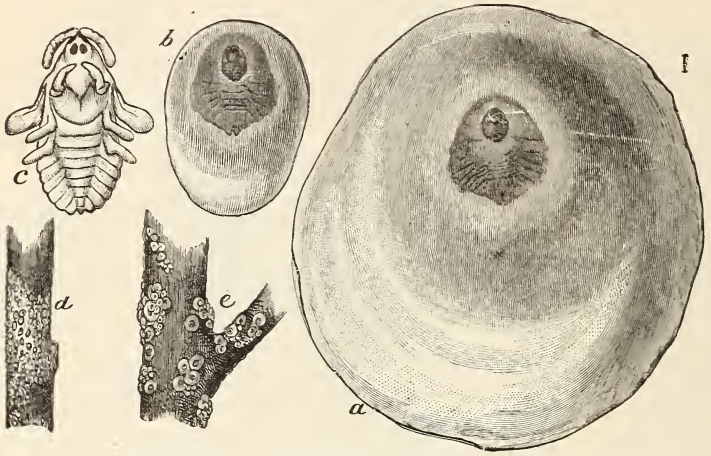

FIG. 9.—*Aspidiotus juglans-regiæ: a*, female; *b*, male; *c*, pupa; *d*, *e*, infested twigs. (Howard.)

THE GREEDY SCALE.

(*Aspidiotus rapax* Comstock—fig. 10.)

This is quite a large species, readily distinguished from the others we have treated by its very convex scale and uniform drab or yellowish-brown color, except for the dark brown exuvium which often shows near the center. The adult female scale is less circular than most of the other species, and does not always show the exuvial spot, which is at one side and covered with a film of secretion. The male scale is much smaller, and elliptical in outline. The young are nearly circular, with a central nipple often surrounded by a pale gray ring. This scale is very abundant in California and has spread somewhat eastward, especially in the South. It attacks various orchard trees, but more commonly the orange. It is a scale that is liable to be found more commonly in the future, and orchardists should be on the lookout for it. The greedy scale, in California, winters in all stages.

THE GRAPE SCALE.

(*Aspidiotus uvæ* Comstock.)

This is a more or less elliptical scale, with the exuvium rather nearer one end. It has a yellowish or pale brownish color, with a whitish center near the exuvium, the latter of a pale yellow. The scales are often found in a longitudinal row, and rarely infest both sides of the

same branch. It winters in the egg stage. The young hatch in May; the males issue in the summer. There is but one brood a year. It is practically confined to the grape, but has been found on a few other plants, and may spread to fruit trees.

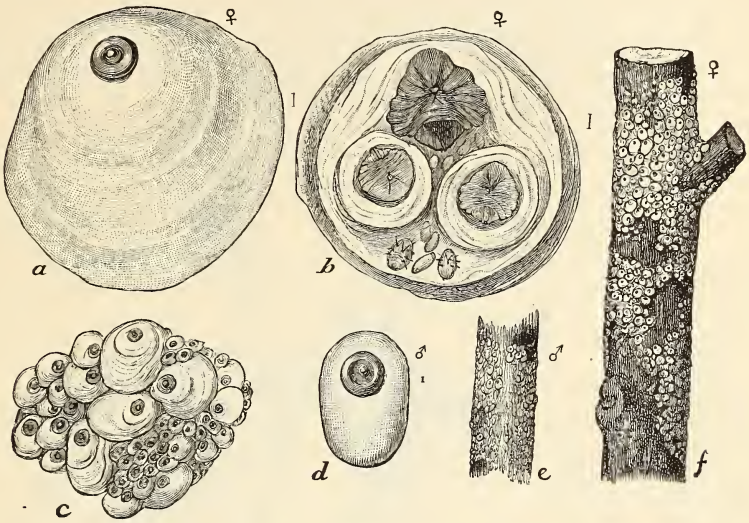

FIG. 10.—*Aspidiotus rapax.* Scales on twigs, and enlarged. (Howard.)

THE PEACH SCALE.

(*Diaspis pentagona* Targ. Tozz.—fig. 11.)

The peach scale, sometimes known as the "whitewash scale," is of a grayish white color, rather flat and irregularly circular or slightly

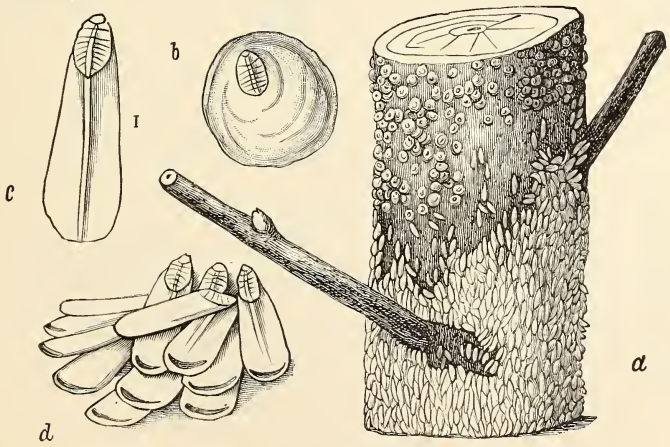

FIG. 11.—*Diaspis pentagona: a*, infested branch; *b*, female; *c*, male; *d*, group of males. (Howard.)

ovate in outline, never as elongate as the scurfy bark-louse. The exuvium is often a little way from the margin, and is yellowish or

orange in color. Its pale color and elongate exuvium will readily separate it from all other scales on orchard trees. The insect passes the winter with the mature females and the male scales. The males hatch in early spring. The eggs are laid early in May, and the larvæ hatch in about ten days. The males again commence to issue by the middle of June, and the females begin egg-laying by the end of June. The second generation is full grown by the middle of August, and these in time soon begin to lay eggs for the brood that will winter as mature females and undeveloped males.

FIG. 12.—*Aulacaspis rosæ*; *1*, infested branch; *1a*, female; *1b*, male. (Comstock.)

The male scale (fig. 11, *c*, *d*) is elongate, about three times as long as broad, slightly wider behind than in front, with a median keel, and snow white in color. The male scales appear to be most numerous on the lower parts of the branches and near the base of the trunk and often so matted as to make the trunk or lower branches absolutely snow white. The peach scale is becoming common in many of the Southern States and as far north as Pennsylvania. It infests plum, cherry, and peach, and less commonly other plants.

THE ROSE SCALE.

(*Aulacaspis rosæ* Sandberg—fig. 12.)

This species is similar to the peach scale, and, indeed, the easiest way to distinguish between them is by their host plants. The peach scale does not affect the host plants of the rose scale, which are roses, raspberry, and blackberry. The scale covering is much more thin and delicate and the exuvium is usually of a paler or duller yellow than in the case of the peach scale. The keel or ridge of the male is more distinct. The life history of this species does not appear to be well known in this country. It winters, as a rule, in the egg as far north as New Jersey; but mature females and immature females and males may be found in winter. In the early spring one often finds the female scales surrounded by a radiate row of male scales. It is probable that there is more than one brood in a year, at least in the South.

FAMILY APHIDÆ (PLANT-LICE).

The plant-lice are small, sluggish insects found on the under surface of leaves or on the bark and roots. Most of the individuals have no wings, but at times one finds some specimens with delicate transparent wings laid roof-like over the body. They all have distinct legs, a pair of moderately long antennæ, and usually quite prominent eyes. They occur in colonies, and by their numbers often do a considerable amount of damage. The eggs are found on trees in winter situated near the base of twigs and buds. (See fig. 13.) They are minute, oval, or elliptical shining black objects. During the warm part of the year the females produce living young, so that one individual may, in a few months, be the parent of a large colony. Many of the species secrete a sweetish liquid from two pre-apical tubes or cornicles. This liquid is known as honey-dew, and attracts other insects, especially ants.

FIG. 13.—Eggs of a plant-louse on twig. (Original.)

TABLE OF PLANT-LICE.

A. Plant-lice on the bark or roots:
   With a whitish, woolly, or cottony covering.....*Schizoneura lanigera.*
   Without such covering.....*Aphis persicæ-niger.*
B. Plant-lice on the leaves:
   With bluish-white mealy powder; on plum.....*Hyalopterus pruni.*
   Dark brown; on cherry.....*Myzus cerasi.*
   Green, or faintly reddish; on apple.....*Aphis mali* and *A. sorbi.*

THE WOOLLY APPLE APHIS.

(*Schizoneura lanigera* Hausmann—figs. 14 and 15.)

One often notices on the trunk or larger branches of the apple

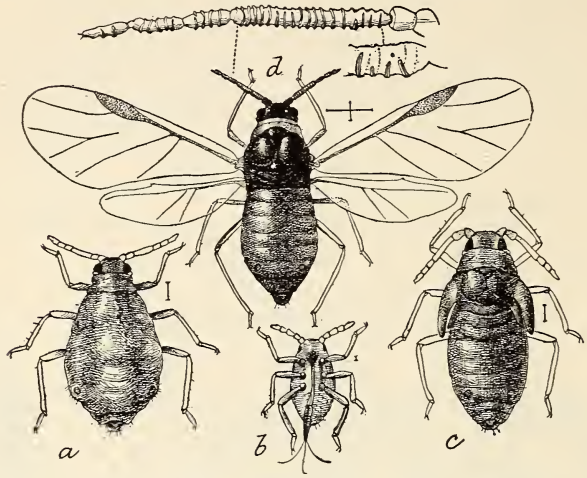

FIG. 14.—*Schizoneura lanigera; a*, agamic female; *b*, larva; *c*, pupa; *d*, winged female. (Marlatt.)

small, bluish-white, flocculent patches of a woolly substance, which indicate the presence of this insect. This cottony substance is a wax-like excretion clinging to the posterior parts of a small, reddish-brown wingless aphis. It is not, however, this form on the trunks that causes injury. This aerial form is but the indication that there are other specimens, under the ground and feeding on the roots of the tree. It is the latter form that seriously affects the vitality of the tree. Upon the trunk the lice often cause a roughening of the bark, especially on the new growth around scars made by pruning. On the roots the lice cause hard and large knots, which eventually produce a "club-footed" condition of the roots. Such trees usually show their weakness by the fewer and duller colored leaves.

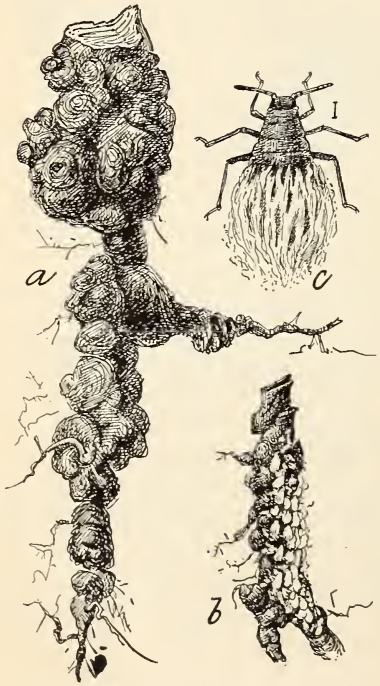

FIG. 15.—*Schizoneura lanigera; a, b*, work on roots; *c*, a louse. (Marlatt.)

The woolly aphis is practically confined to the apple, but there are a few varieties, such as the Northern Spy, that appear to be immune against its attacks. The lice com-

monly found on the trunk and roots in summer are the wingless, agamic females. They give birth to living young, and continue to do so, possibly for several years. In spring some of the root-lice will crawl up the trunk and continue to breed there till fall. The colonies of lice on the trunk give rise to winged and migratory females. These, when they locate, give birth to wingless male and female lice, and each female deposits a single winter egg in a crevice of the bark. This egg will, in the spring, hatch into a female which will start a new colony of wingless lice on the trunk. Some of these will, in the summer, crawl down upon the roots and continue to breed there. In the north the colonies on the trunk are apt to be killed out by the severe cold weather, but in warmer latitudes many of them live through the winter, particularly if they are protected by a piece of bark.

THE BLACK PEACH APHIS.

(*Aphis persicæ-niger* E. F. Smith—fig. 16.)

This insect, like the woolly apple aphis, does its great injury underground. Its ravages on the roots of peach give a sickly appearance to the foliage of the affected tree, the leaves often being light green or

FIG. 16.—*Aphis persicæ-niger;* winged specimen. (J. B. Smith.)

yellowish in color, and their edges somewhat rolled. The wingless lice on the roots are of a dark-brown color. They breed there continuously without producing males or eggs. Early in the spring some of the root-lice crawl up the trunk of the tree and locate on the young twigs. Here the winged form develops and migrates to other trees to found other colonies. The winged insect is of a shining black or very dark brown color, the tibiæ of the legs being mostly yellowish.

Toward midsummer many of the lice on the twigs crawl down into the ground and locate upon the roots.

APPLE PLANT-LICE.

The foliage of apple trees, particularly of young trees, often appears curled, and sometimes discolored. This curling is produced by colonies of plant-lice. These lice secrete a sticky liquid known as honey-dew, which falls on the leaves below. A black fungus grows upon the leaves covered by the honey-dew, and this checks their growth. There are several of these plant-lice that attack the leaves of apple; two of them are greenish in color, another has a reddish tinge.

The commoner of the two green species is known as *Aphis mali* Fitch. (probably *Aphis annuæ* Oest). Its life history is about as follows: The eggs are laid on the tree in the fall, partly hidden in crevices of the bark; the young hatch from these eggs in early spring, and grow into wingless and sexless lice, known as "stem-mothers," which produce living young; these young become winged, and, in the early summer, migrate to grasses, where they increase during the summer. In the fall they develop a set of winged, sexless lice, which migrate back to the apple and give birth to sexed individuals; these pair, and the female lays her eggs.

The other green species is *Aphis mali* Koch. It passes its entire life history upon the apple. The eggs are laid in the late fall. They are black, and occur generally on the trunk and branches. In early spring the young hatch from these and grow into stem-mothers. These produce living young for a number of generations. Many of these of the first two generations become winged, fly to other apple trees, and there start colonies. In October sexed specimens are produced, and the female lays the eggs that are destined to pass the winter.

The other apple plant-louse is *A. sorbi* Kalt. It is distinctly tinged with red, and the wingless forms have a whitish powdering on the body. This species has a life history similar to that of *Aphis mali* Fitch., but it is not known what plants serve as its summer hosts.

THE PLUM PLANT-LOUSE.

(*Hyalopterus pruni* Fabr.)

This insect winters in the egg state. The young on hatching in spring go to the under surface of the leaf and there multiply rapidly. Their bodies are covered by a bluish-white mealy powder. Winged specimens are occasionally developed which migrate to other trees. They feed on the plum all summer, but some specimens are said to migrate to grass in early summer. In the fall the winter egg is attached to a plum twig, usually at the base of a bud. At times they do considerable damage to young plum stock.

THE CHERRY APHIS.

(*Myzus cerasi* Fabr.)

This aphis often causes the leaves of the cherry to become crumpled and rolled, and on young trees sometimes does serious damage. The winged and wingless insects are both of a dark brown color, and look much like the black peach aphis. The eggs are laid in the fall on the branches at the base of buds and in crevices of the bark. The young hatch from them in the spring when the buds begin to swell, crawl out upon the buds and growing leaves, and develop into stem-mothers, which give birth to living young. This is kept up all summer until the fall, when the sexes appear and the female deposits her eggs. A number of winged migrants are developed in the spring generations, which serve to spread the species. The insects usually become very abundant by June, but in midsummer they are not as common.

FAMILY PSYLLIDÆ.

THE PEAR-TREE PSYLLA.

(*Psylla pyricola* Forster—fig. 17.)

This insect is closely related to the plant-lice, but readily known by its longer antennæ and its ability to hop. Its color is reddish, with

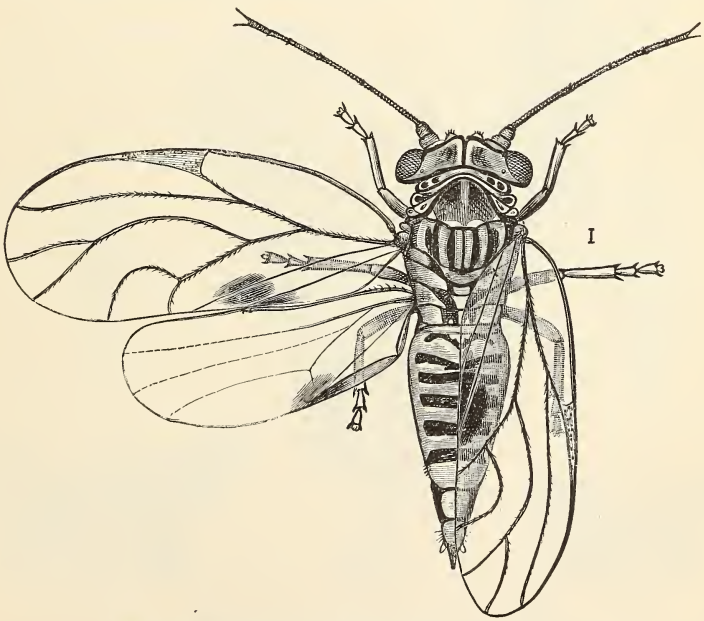

FIG. 17.—*Psylla pyricola;* greatly enlarged. (Marlatt.)

some black markings, and with clear wings laid roof-like over the body. When disturbed, it hops and flies away.

The insect is widely distributed in the East, but usually is not abundant enough to seriously injure the tree. When they become excessively abundant they cause the leaves and fruit to dry and fall. The adult insect hibernates in crevices of the bark. These overwintering specimens are brownish-black in color, with bronzy eyes. They emerge from their hiding places in the early spring, mate, and the female begins to lay eggs before the leaves are out. The eggs are placed singly or in groups in crevices of the bark of the twigs or in old leaf scars, and, when the leaves have unfolded, upon the leaves themselves. The larvæ hatch in about two weeks and begin to suck the juices from the leaves and petioles. They at once commence to excrete honey-dew, and when the insects are extremely numerous the amount of liquid secreted is enormous and fairly rains from the tree. A black fungus grows on the honey-infested leaves and tree, so that the whole soon has a smoked appearance. In about thirty days the larva becomes adult. Development continues all through the summer, and there may be as many a five broods if the season be long enough. It is only known to attack the pear.

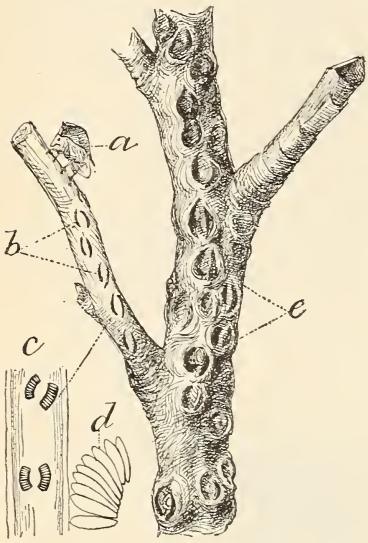

FIG. 18.—*Ceresa bubalis: a*, insect; *b*, recent punctures; *c*, eggs; *e*, old scars. (Marlatt.)

FAMILY MEMBRACIDÆ.

THE BUFFALO TREE-HOPPER.

(*Ceresa bubalus* Say—fig. 18.)

Upon young fruit trees, particularly the apple, one sometimes sees a series of oval or elliptical scars that disfigure and weaken the branches and render them liable to other insect attack. These scars are the results of the work of a curious insect, the buffalo tree-hopper. It is a grass-green, triangular insect that hops and flies away when disturbed. The pronotum of the thorax is enlarged, as with others of this family, to cover the head and most of the abdomen. The anterior corners of the pronotum project laterally into acute angles. In August and September the adult insects may be found on the trees engaged in oviposition. The female cuts the bark with her ovipositor in two nearly opposite curved slits, so that the bark between is cut loose. Beneath each slit she deposits a series of from 6 to 12 eggs. These eggs hatch in the spring. The dead piece of bark falls out and leaves the elliptical scar, which enlarges with the subsequent growth of the twigs and becomes an inviting point for the attack of other insects. There is but one brood each year.

LEPIDOPTERA (BUTTERFLIES AND MOTHS).

The caterpillars and cocoons of these insects are known to all. The caterpillars differ from the grubs of beetles in that they have on the under side two rows of prolegs—fleshy, wart-like structures that serve to support the posterior part of the body. The injuries caused by these insects are made by the caterpillar. These have biting mouth-parts that nip out tiny pieces of the leaf or wood, which is then chewed and swallowed. The more injurious forms that are liable to be transported on nursery stock may be arranged as follows:

1. Feeding within the trunk ..... Peach-tree borer.
   Feeding within the twigs or leaf-shoots ..... Peach twig-borer.
   Feeding upon the leaves ..... 2.
2. The insect covered by a case ..... Bagworm, leaf-crumpler, pistol-case bearer, cigar-case bearer.
   The insect not covered by a case ..... 3.
3. Making tents or nests ..... Apple-tree tent caterpillar, fall webworm, brown-tail moth, leaf-crumpler, and bud moth.
   Without tents ..... 4.
4. Hairy caterpillars ..... Tussock moth, gipsy moth.
   Bare caterpillars ..... Cankerworms.

THE APPLE-TREE TENT CATERPILLAR.

(*Clisiocampa americana* Harr—fig. 19.)

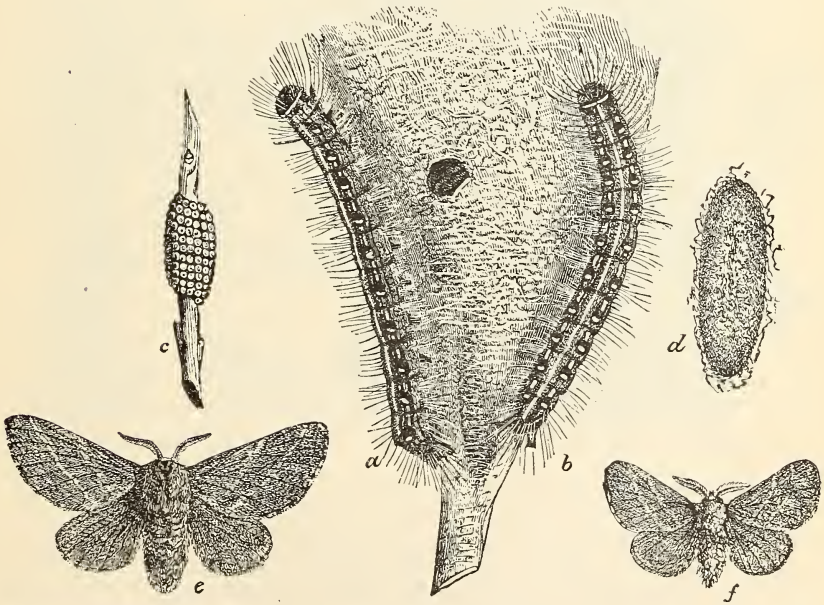

FIG. 19.—*Clisiocampa americana*: *a*, *b*, caterpillars; *c*, egg-mass, *d*, pupa; *e*, female; *f*, male. (Riley.)

The webs or tents of this caterpillar are frequently found on orchard and nursery trees in May and June. The caterpillars use this tent as

a common home, where they retire at night and remain during cloudy days. Each clear morning, at about 8 o'clock, they go out along the branches to the leaves for feeding. The amount of damage done will depend a great deal upon the number of tents upon the tree. The eggs are laid in masses of 200 or 300 arranged in a broad belt around the twig. (See fig. 19, *c*.) Each end of this belt tapers off to the twig, which character serves to distinguish it from similar egg-clusters of certain other moths. Each mass is covered with a glistening substance that protects it from the rain. The young caterpillars hatch during the latter part of April or early in May, at about the time when the leaves are expanding. They immediately begin to feed on the leaves near by and to unite them into their tent, which is enlarged as the caterpillars grow. The full-grown larva is nearly 2 inches long, hairy and black, with a white stripe along the back. On each side of this is a row of short, yellow streaks; there are also pale lines on the sides of the body. The under side is nearly black. When ready to pupate the caterpillar seeks some protected spot and there spins its yellowish cocoon, and soon changes to a brown chrysalis. The moth, which is brown, with oblique white bands across the forewings, emerges in a week or so and deposits her egg-mass and dies. There is but one brood a year.

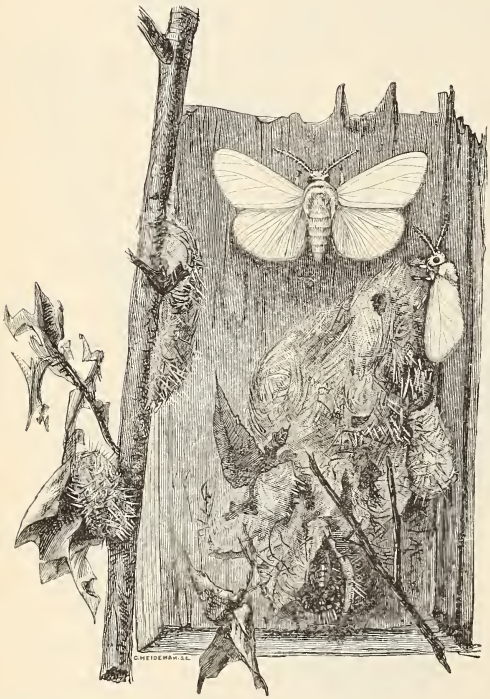

FIG. 20.—*Hyphantria cunea:* moths and cocoons. (Howard).

THE FALL WEBWORM.

(*Hyphantria cunea* Dru.—fig. 20.)

During the summer and early fall webs or tents similar to those of the apple-tree tent caterpillar are often seen among the terminal branches of fruit trees. These are the work of the fall webworm. The eggs of this moth, 300 to 500 in number, are laid in patches on either side of the leaves in June. The larvæ issue from June to August, and at once begin their web. They eat only the upper surface of the leaf, leaving the veins and the under surface untouched. The young caterpillar is pale yellowish, with dark spots along the sides and covered with scattered hairs. The full-grown

caterpillar is velvety black above, the sides have two yellow stripes, and between them are many blackish patches and dots. The yellowish or brownish hairs are mostly in tufts which arise from tubercles or warts. Some specimens are quite pale; others very dark. In September or October the caterpillar is ready to pupate, and descends to the main branches or trunk of the tree. Here it makes a delicate cocoon, within which it changes to a chrysalis. The insect passes the winter in this stage, and the moth emerges the following spring. The latter has white, sometimes spotted wings, and expands about an inch and a half. There is but one brood each year in the North, but from New York city south there are two broods, the caterpillars of the second making their appearance in August.

THE BROWN-TAIL MOTH.

(*Euproctis chrysorrhœa* Linn.—fig. 21.)

This insect, at present confined to certain parts of eastern Massachusetts, is such a dangerous pest that all interested in nursery trade

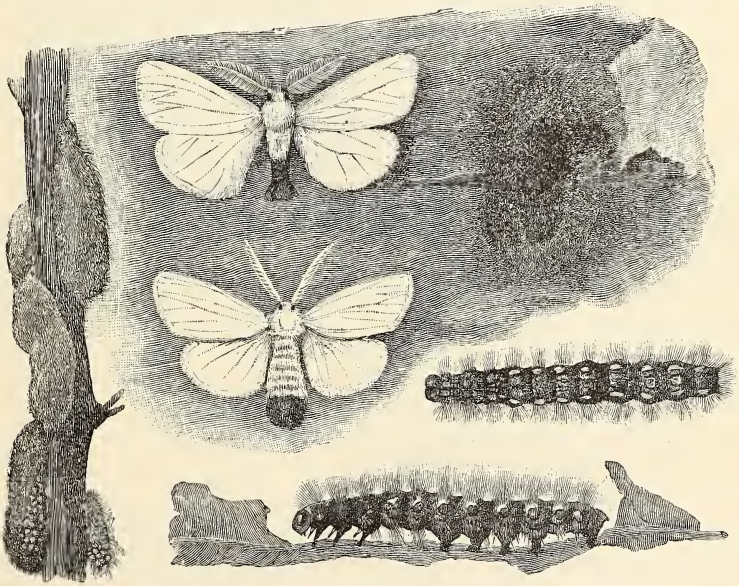

FIG. 21.—*Euproctis chrysorrhœa.* Moths, larvæ, and cocoons. (Howard.)

should be able to recognize it. During winter their small but very compact webs or nests attached to the terminal twigs are very prominent objects and will aid in distinguishing the species. In midsummer the eggs may be found in patches of two or three hundred attached to the under side of a leaf near the tip of a branch. The egg mass is covered by a dense layer of brown hairs from the tip of the abdomen of the female. The young hatch in August and eat the surface of the leaf. As soon as it is devoured they draw another leaf to it, until

in the fall they have quite a tent. On the approach of winter they strengthen their tent and use it to shelter them during the winter. In spring they come out, eat the unfolding buds and tender leaves, and thus do great damage. The full-grown caterpillar is about 1½ inches long, dark brown, mottled, and spotted with orange, and clothed with reddish-brown hairs and two rows of dense tufts of white hair along the upper side of the body. By the middle of June the caterpillars are ready to pupate, and each makes a cocoon attached to a terminal branch, or sometimes elsewhere on the tree, or even on some other object. These cocoons are often close to each other, so as to form quite a mass. The moths emerge in a few weeks. They have white wings, and the females a brown tip to the abdomen. There is but one brood each year.

THE LEAF-CRUMPLER.

(*Mincola indiginella* Zell.)

The presence of this insect is easily recognized in winter by the clusters of brown, shriveled, and partly eaten leaves fastened together and to the twigs by silken threads. Within each cluster of leaves is a curved tube, usually sinuate at the small end, and within this tube is the small, brownish caterpillar of this moth. This caterpillar is but half grown. In early spring the larva cuts loose from its fastenings, crawls with its case out upon the branches, and attacks the developing buds and young leaves, thus causing a great deal of injury. The caterpillar becomes full fed by the middle of May, and is then of a greenish color. It pupates in the larval nest, and the moths issue in June or early July. The eggs are deposited in July, singly on the leaves. The young larva, upon hatching, starts to make a little case for itself, which it enlarges when necessary. They feed on all fruit trees, but are partial to apple, and there is but one brood annually.

THE WHITE-MARKED TUSSOCK MOTH.

(*Orgyia leucostigma* S. & A.—fig. 22.)

The caterpillar of this moth, which does great damage to shade trees in cities, sometimes attacks apple and other fruit trees. The adult insect is a light-grayish moth, the female wingless, the male with ash-gray wings, expanding about 1¼ inches, and the antennæ are feathered. The eggs, 300 to 500 in number, are laid by the wingless female in the fall within a frothy substance, which on drying becomes hard and brittle. The whole is a very prominent whitish mass, often situated partly or wholly upon the old cocoon. In May the young larvæ hatch and begin eating the foliage. The larvæ are full-grown in July, and spin their slight silken cocoons, attached to any convenient spot. The full-grown caterpillar is a very handsome insect, about 1½ inches in

length, yellowish, with three blackish stripes along the body, and a bright-red head. It is clothed with long, scattered hairs, four white

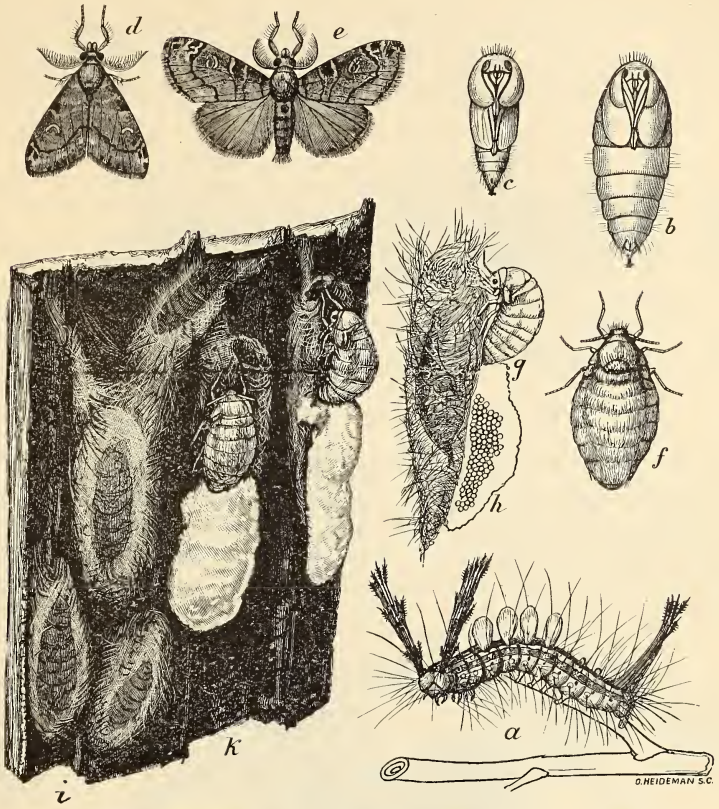

FIG. 22.—*Orgyia leucostigma.* Various stages; eggs at *h* and *k*. (Howard.)

tufts on the anterior part of the body, and three long black plumes, two in front and one at the tip of the body. In the North there is but one brood a year, but from New York city south there are usually two broods, the caterpillars of the second appearing in early August.

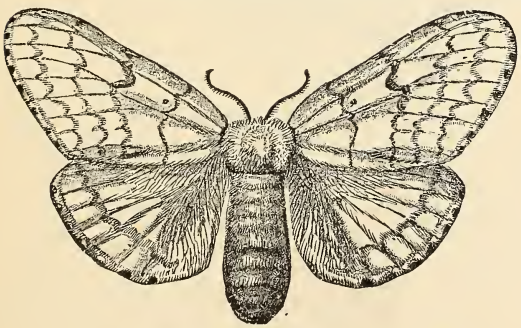

FIG. 23.—*Porthetria dispar:* female moth. (Howard.)

THE GIPSY MOTH.

(*Porthetria dispar* Linn—figs. 23, 24, and 25.)

Although practically confined to certain parts of Massachusetts, this insect is quite liable to spread, and all interested in orchards and nurseries should be able to recognize this caterpillar.

The eggs to the number of 400 to 500 are deposited in clusters attached to trees, fences, etc. Each cluster is covered with yellow hairs from the body of the female, which causes the mass to resemble a piece of sponge. The caterpillars hatch from April to June, and feed voraciously on the leaves, mostly at night. The full-grown caterpillar is about 2 inches long, of a grayish, mottled appearance, with the tuber-

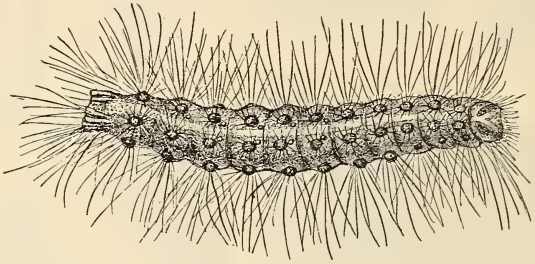

FIG. 24.—*Porthetria dispar.* Larva. (Howard.)

cles on the anterior part of the body blue, and those on the hinder part of the body red, all giving rise to long yellow and black hairs. When the caterpillars are about half grown they begin to crawl down the tree to the ground in early morning, and ascend again for feeding in the evening. By July they are ready to pupate in a thin cocoon fastened

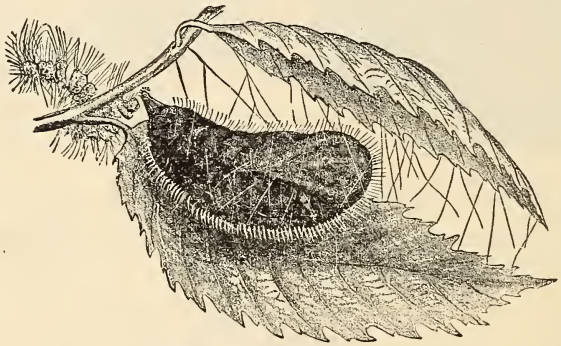

FIG. 25.—*Porthetria dispar.* Chrysalis. (Howard.)

to the trunk of the tree, to a fence, or other convenient object. The pupal period is about ten days, and the moths issue in August. The female moth has whitish wings with several black spots, notably around the outer margin. The male is brownish, with darker undulate lines and spots. The gipsy moth attacks almost every sort of tree, and there is but one brood a year.

CANKERWORMS.

(Figs. 26, 27, 28, and 29.)

These slender, bare caterpillars appear on apple and other fruit trees in early spring and eat holes in the leaves. As they crawl they loop up the body, and are thus called "measuring worms" or "inch worms." There are two species of the cankerworms, their habits, however, being similar. The eggs are laid in clusters on the tree in the fall and early winter, with the fall species (*Alsophila pometaria* Harr.); in March or April with the spring species (*Paleacrita vernata* Peck). The eggs of the former are flattened on top; those of the latter are rounded. The larvæ hatch in early spring and at once feed on the leaves. When full grown they descend to the ground and pupate therein, the moths issuing in late fall or very early spring. The females are wingless, and obliged to crawl up the tree to deposit eggs. The males have large, thin, gray wings. There is but one brood each year.

FIG. 26.—*Alsophila pometaria: a*, male; *b*, female. *c*, *d*, details. (Riley.)

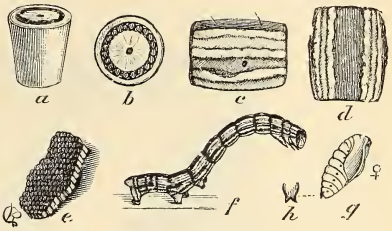

FIG. 27.—*Alsophila pometaria: a*, *b*, *c*, eggs; *f*, larva; *c*, *d*, segments of same; *g*, pupa. (Riley.)

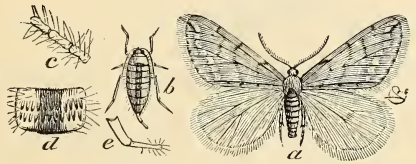

FIG. 28.—*Paleacrita vernata: a*, male; *b*, female, *c*, *d*, *e*, details. (Riley.)

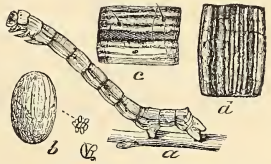

FIG. 29.—*Paleacrita vernata: a*, caterpillar; *b*, egg; *c*, *d*, segment of caterpillar. (Riley.)

THE PEACH-TREE BORER.

(*Sanninoidea exitiosa* Say—fig. 30.)

This destructive insect is readily discerned by the presence of a gummy exudation mixed with frass and excrement at or near the base of the tree. The parent moth lays the eggs singly (from May to July, according to latitude) on the bark of the tree, usually near the base. The young larva burrows into the bark and mines between it and the

sapwood during the summer and fall. It is quiescent during the winter, but resumes feeding in the early spring, reaching full growth by May or June. The caterpillar is then a little over 1 inch in length, soft, and pale yellowish in color, with a shining, dark-brown head. It transforms to a chrysalis within an elongate cocoon just beneath or sometimes outside of the bark. The moths emerge in May

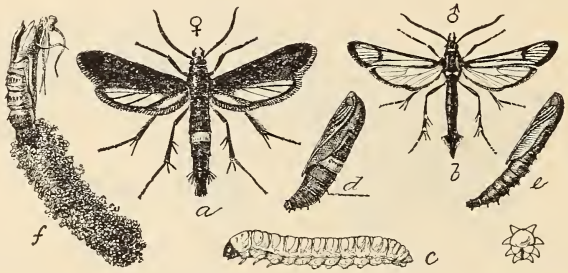

FIG. 30.—*Sanninoidea exitiosa: a*, female; *b*, male; *c*, larva; *d*, *e*, female and male pupæ; *f*, cocoon. (Marlatt.)

or June. The female has dark-blue fore-wings; the male has clear ones. It primarily attacks peach, but sometimes cherry and plum. There is but one brood each year.

THE PEACH TWIG-BORER.

(*Anarsia lineatella* Zell.—fig 31.)

The presence of this insect in the winter is quite readily known by bits of frass attached to the bark, often at the crotches of branches or twigs. Each bit of frass covers the entrance to a small burrow lined with silk, within which the young larva of this insect passes the winter. It is now of a yellowish color, with the head and thoracic segments, as well as the last segment, almost black. Early in spring, when the leaves are coming out, the larvæ abandon their burrows and attack the tender leaf shoots, boring into them from a point a little below the apex, and when one shoot commences to dry the larva leaves it and attacks another. In about two weeks the larva is full grown, and pupates in a slight open cocoon attached to the bark or among the shriveled leaves. The tiny, grayish moth issues in May. Two broods follow this, the larvæ boring in the young twigs

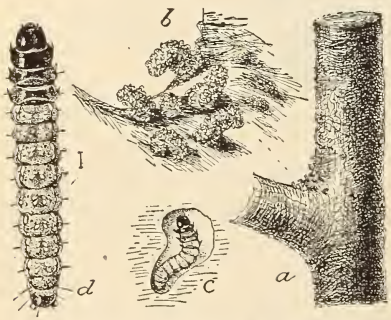

FIG. 31.—*Anarsia lineatella: a*, infested twig; *b*, same enlarged; *c*, larva in case, *d*, larva enlarged. (Marlatt.)

or sometimes in the immature fruit. The larva from the second brood makes the little burrows in the bark in which the insect passes the winter. The peach twig-borer feeds on all stone fruits.

THE BAGWORM.

(*Thyridopteryx ephemeræformis* Haw.—figs. 32 and 33.)

The winter cases or bags of this insect, 1½ to 2 inches long, are often seen hanging from the branches of shade trees, particularly arbor-

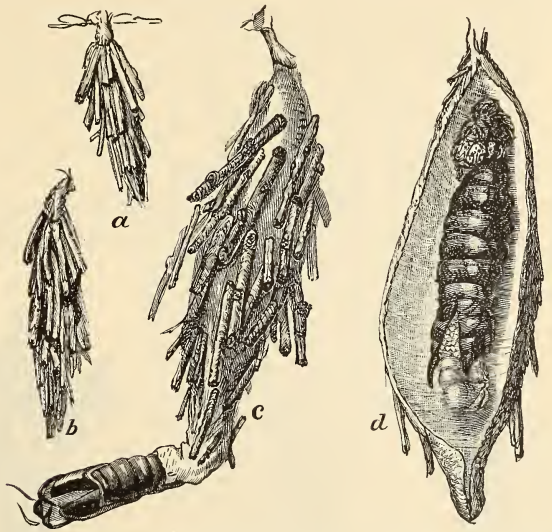

FIG. 32.—*Thyridopteryx ephemeræformis.* Cases; *d*, one cut open. (Howard.)

vitæ, locust, and basswood, but are not so common on fruit trees. The adult insect is a moth; the female wingless; the male with four

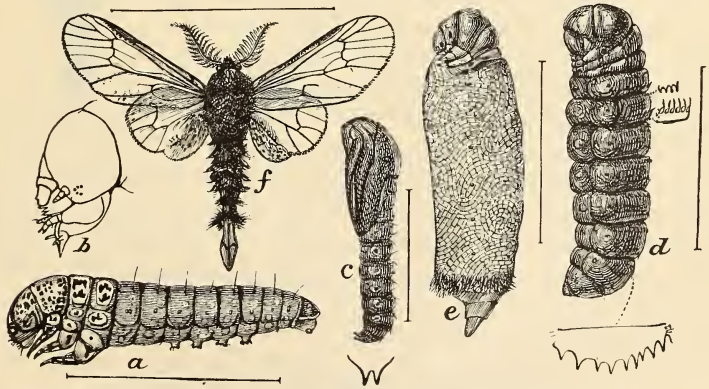

FIG. 33.—*Thyridopteryx ephemeræformis: a*, larva; *b*, head of same; *c*, male pupa; *d*, female pupa, *e*, adult female; *f*, adult male—all enlarged. (Howard.)

transparent wings and a black body. The female never leaves her case alive, but in the fall deposits her eggs therein, drops out and dies,

the case remaining attached to the tree all winter. In May the young hatch, and at once start to make little cases for themselves, which they enlarge as they grow. When ready to pupate, the caterpillar fastens its case to a twig and transforms to the chrysalis. The male moth appears in August. There is but one brood a year.

OTHER CATERPILLARS.

On the apple tree in winter one may find several other caterpillars in various stages of development. One of them, the pistol-case bearer (*Coleophora malivorella* Riley), is a small larva with a dark head. It carries with it a case the tip of which is curved over, the whole about one-eighth inch long. It feeds on the buds and leaves in spring. In the fall it fastens itself securely to the twig, and thus passes the winter in an immature condition.

FIG. 34.—Larva of bud-moth. (Slingerland.)

Another is the cigar-case bearer (*Coleophora fletcherella* Fern.). It has a life history similar to the preceding, but its case is straight, not curved. Both feed on the pear and quince.

Small, elongate, white, ribbed cocoons, nearly one-fourth of an inch long, often in clusters, are sometimes seen on apple bark in winter. They indicate the presence of the apple-leaf bucculatrix (*B. pomifoliella* Clem.). In spring the tiny, delicate moths issue from the cases. The larvæ mine the leaves. There are two broods annually.

FIG. 35.—Work of bud-moth larvæ in opening twigs. (Slingerland.)

Small, inconspicuous cases, covered with particles of dirt and bark, are, at times, found on the bark of the apple and pear. These contain the half-grown larva of the bud-moth (*Tmetocera ocellana* Schif., figs. 34 and 35). In spring the larva feeds on the buds and young leaves, webbing the leaves in a bunch or nest. They pupate within this nest. The moth issues in July, and is a grayish insect with a creamy white patch on each fore-wing. During the summer the young larvæ partially skeletonize the leaves, feeding beneath a thin silken web. As winter approaches they migrate to the twigs and form their hibernating cases. There is but one brood a year.

COLEOPTERA (BEETLES, WEEVILS).

Beetles are easily known by the hard, coriaceous fore-wings that cover and protect the back of the abdomen. Both in the larval and the mature conditions they have biting mouth-parts, and injury is

sometimes done by both the grub and the beetle. The grubs, to reach the adult condition, pass through a complete change or metamorphosis, like caterpillars, but do not spin a silken cocoon. The grubs do not have the prolegs that are found in caterpillars. The forms to be noticed below may be arranged as follows:

1. Boring in the twigs ..... Apple twig-borer.
   Boring in the trunk or larger branches ..... 2.
2. Making tiny circular holes in the bark ..... Fruit-tree bark-beetle.
   Making a sinuate crack or depression ..... Sinuate pear borer.
   Discolored spots on the bark ..... Round-head and flat-head apple-tree borers.

THE ROUND-HEADED APPLE-TREE BORER.

(*Saperda candida* Fab.—fig. 36.)

Discolored places on the bark near the base of the trunk may indicate the presence of this borer. Sometimes the bark cracks over the burrow and allows the frass or "sawdust" to drop out, and often there

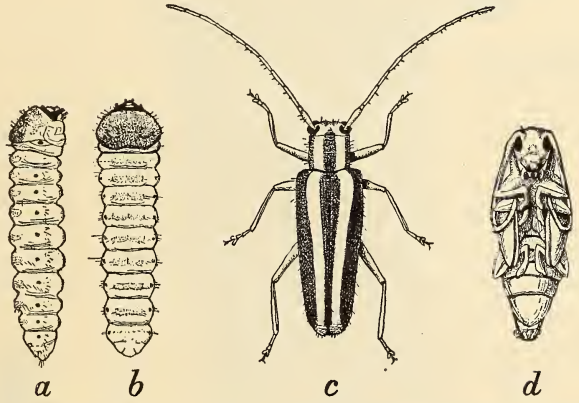

FIG. 36.—*Saperda candida: a, b,* larva; *c,* beetle; *d,* pupa, enlarged. (Chittenden.)

is some exudation of sap. Every unnatural-looking spot near the base of the tree should be examined. The adult of this borer is a grayish, long-horned beetle with two white stripes along its back. They appear in June and July, and lay their eggs in little slits in the bark made by the beetle near the base of the trunk. The larvæ or grubs soon hatch and bore beneath the bark, feeding on the sapwood and inner bark, and making flat, shallow cavities, partially filled with frass. The grubs are nearly cylindrical, pale yellowish in color, and when full-grown about an inch long. On the approach of winter they work downward, often below the surface of the ground. In spring they begin to feed again, boring upward. In this manner they feed all summer until cold weather, when they again hibernate. In the spring they resume work, but now they bore more irregularly and further into the tree. In early fall they bore close to the surface, work back

a little, and then pupate. Winter is passed in this condition, and in June the beetles cut *circular* holes in the bark and escape. It thus takes three years to reach maturity. This borer also infests pear and quince, but not so frequently as the apple.

THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata* Fab.—fig. 37.)

Discolored spots like those caused by the round-headed borer may indicate the presence of this insect. They are, however, often found farther up the trunk, and even on the larger branches. The adult is a dark, metallic beetle, rather flat, and about one-half inch in length. The female deposits her eggs in crevices of the bark on the south side of the tree, usually during June and July, but sometimes later. They apparently prefer trees that are weak or dying, but also attack healthy ones. The young larva upon hatching eats through the bark and bores beneath the surface, leaving a flattened burrow filled with its frass. Sometimes, when more mature, they bore deeper into the sapwood. The full-grown larva is nearly an inch in length, pale yellowish in color, with the segment next to the head greatly enlarged and flattened. In the spring it bores out nearly through the bark, then moves back a little and pupates. In about three weeks the beetle cuts an *elliptical* hole in the bark and escapes. There is one brood each year. It attacks apple, pear, cherry, plum, and quince.

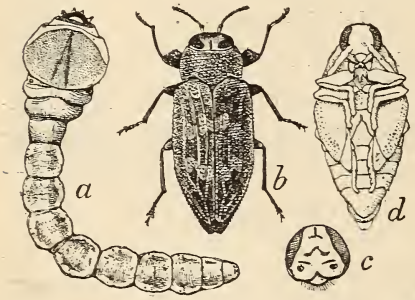

FIG. 37.—*Chrysobothris femorata: a*, larva; *b*, beetle; *c*, head of male; *d*, pupa, enlarged. (Chittenden.)

THE SINUATE PEAR BORER.

(*Agrilus sinuatus* Oliv.—figs. 38 and 39.)

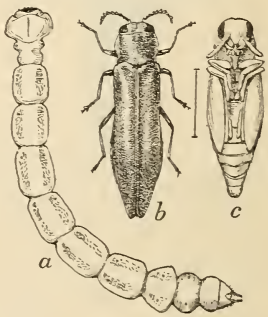

FIG. 38.—*Agrilus sinuatus: a*, larva; *b*, beetle; *c*, pupa, enlarged. (Original.)

The larva of this insect bores long, sinuate galleries beneath the bark and sapwood of pear, killing the wood and causing the bark above to crack. The elongate bronzy beetle makes its appearance in May or early June, and lays its eggs in crevices of the bark. The slender, whitish larva burrows beneath the bark, always downward. In the fall the larva becomes dormant, and is then about 1 inch long, quite flat, whitish or yellowish in color,

with a brown head, and the segment next to the head much enlarged. In spring the larva resumes feeding and makes broader burrows than in the first year. In late summer or early fall, when full fed, it bores about one-fourth inch into the wood, and there forms an elon-

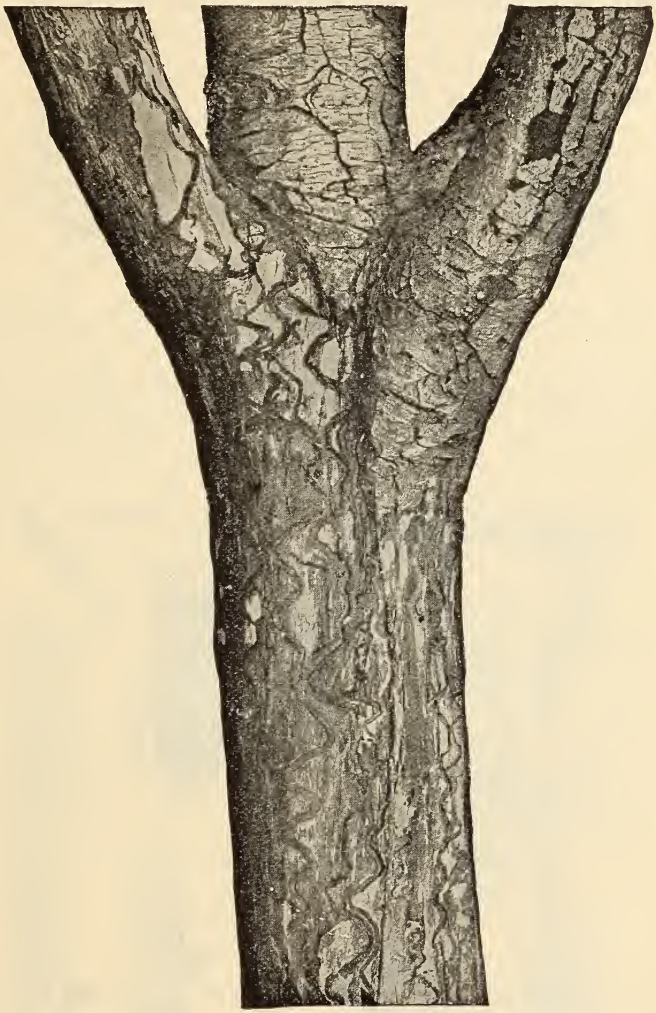

FIG. 39.—Work of *Agrilus sinuatus*, reduced. (Smith.)

gate cell parallel with the bark and connected to the outside by an exit hole. Within this cell it winters, pupates in April, and the beetle issues in May or June. It thus takes about two years to reach maturity.

THE FRUIT-TREE BARK-BEETLE.

(*Scolytus rugulosus* Ratz.—fig. 40.)

Small circular holes in the bark of fruit trees indicate this insect, known also as the "peach bark-borer" or "shot-hole borer." The

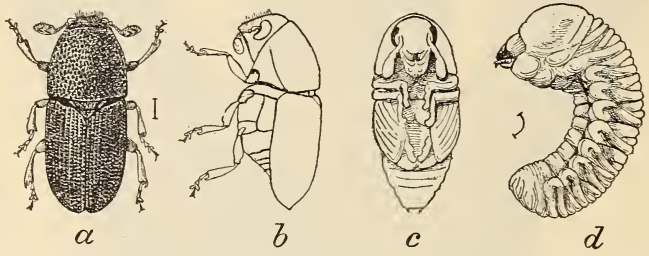

FIG. 40.—*Scolytus rugulosus: a*, *b*, beetle; *c*, pupa; *d*, larva; all enlarged. (Chittenden.)

adult insect, a tiny black beetle, appears in the latter part of March to the middle of May, and burrows through the bark. Between the bark and sapwood the female makes a burrow and lays her eggs along each

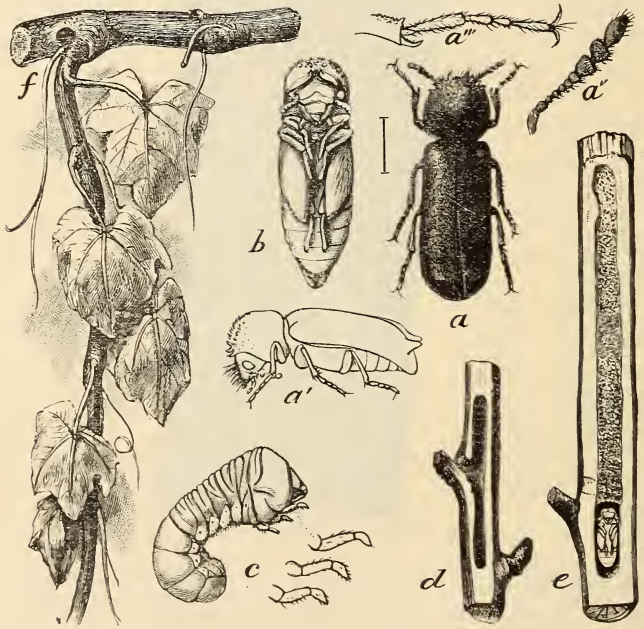

FIG. 41.—*Amphicerus bicaudatus: a*, beetle; *b*, pupa; *c*, larva; *d*, winter burrow; *e*, larval gallery; *f*, work in grape. (Marlatt.)

side. The young upon hatching bore away from the parental burrow, and in about three weeks are ready to pupate at the end of the gallery.

In about a week the beetles bore out from their burrows. The result is that the bark is loosened and sometimes the tree girdled. When they attack peach there is a great exudation of sap and a consequent weakening of the tree. There are two and probably three broods a year, but as they start at different times the broods become mixed. It attacks all kinds of fruit trees, and prefers trees that are dying, diseased, or weakened by other insects, but healthy trees are not exempt.

THE APPLE TWIG-BORER.

(*Amphicerus bicaudatus* Say—fig. 41.)

In the fall and winter the adults of this insect bore into twigs of apple and other fruits, as indicated in fig. 41, *d*. Cutting back from this hole one will find this borer in the adult state—a cylindrical brown beetle about one-third of an inch long. These holes are their hibernating quarters. In the spring the insect works in grape canes, causing the withering of new shoots, as indicated at fig. 41, *f*. In the spring the beetles emerge and insert their eggs in diseased or dying twigs of grape, maple, or other plants; the larva bores through the center of the twig until fall, when it pupates. The beetle issues in late fall, and there is but one brood a year. It attacks chiefly apple, pear, peach, plum, and grape.

ACARINA (MITES).

The mites are not insects, although related to them. They are recognized by lacking the distinction between the head and thorax and by the absence of antennæ. There are usually four pairs of legs, but in the pear-leaf blister-mite and its allies there are but two pairs. Besides the pear-leaf blister-mite, which is treated below, there are often found upon fruit trees in winter numbers of tiny, roundish, red eggs. These belong to a mite known as the clover mite (*Bryobia pratensis* Gar.). They rarely do damage to fruit trees in the East, but feed on clover and similar plants.

THE PEAR-LEAF BLISTER-MITE.

(*Eriophyes pyri* Scheut.)

This is a microscopic mite about one one-hundred and fiftieth of an inch long, with a slender body provided with two pairs of legs near the head end. Although each mite is so small as to do little damage of itself, it may become the parent of a vast assemblage capable of doing a great amount of injury. During the winter the mites remain hidden between the bud scales. Early in spring the mites move to the young unfolding leaves, eat through the under surface, and feed on the interior substance of the leaf. Here the mites increase a thousandfold. Some of these mites move out to form new galls, until a

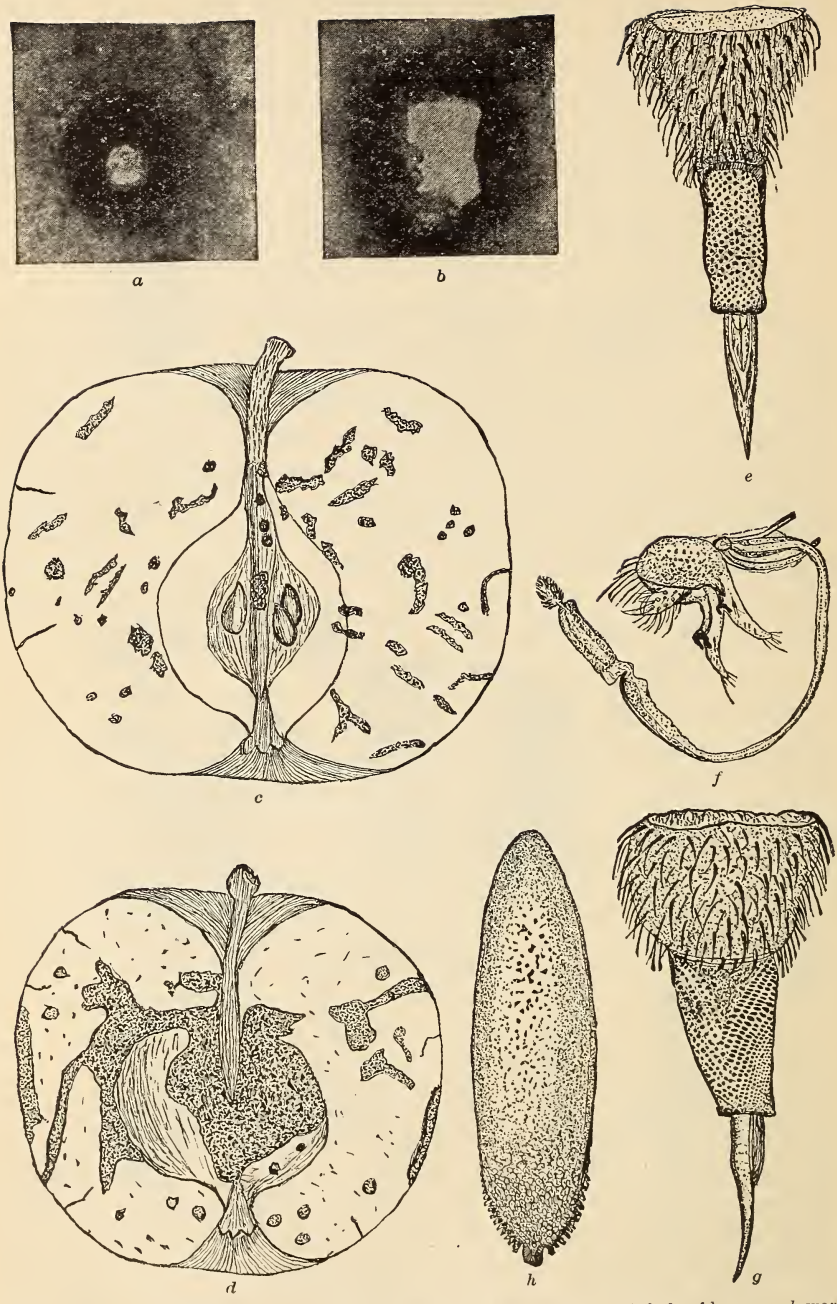

FIG. 42.—*Rhagoletis pomonella: a*, oviposition puncture in apple skin; *b*, exit hole of larva; *c*, *d*, work of larvæ in apple; *e*, *f*, *g*, details; *h*, egg. (Harvey.)

leaf becomes thickly spotted with them. Their feeding causes a thickening of the leaf at that spot, commonly called a blister or gall. This blister is at first of a reddish color, but it gradually turns brown, and finally black. In early fall, when the leaves ripen, the mites leave their galls and take refuge in the buds for the winter.

INSECTS INFESTING FRUITS.

Although few of the insects infesting fruit are liable to be transported upon nursery stock, several of them are such destructive pests as to merit the attention of all interested in horticulture.

* * * * * * *

The codling moth (*Carpocapsa pomonella* Linn.) passes the winter as a caterpillar in a cocoon in crevices or under loose pieces of the bark. However, they are not apt to occur on nursery trees. The cocoon is made of whitish silk and partially covered with bits of bark so that it is not easily seen. In early spring they pupate, and the moths issue to lay their eggs on young apples. The larva bores into the apple, usually from the blossom end, mines to the core, and then, when about full-fed, bores to the surface. It leaves the apple to pupate on the trunk or larger branches of the tree. Some issue in late June or July and again lay eggs on the apple, making a second brood. In the Northeastern States there is but one brood a year. The codling moth also attacks pears and quinces.

FIG. 43.—*Rhagoletis cingulata.* (Slingerland).

The apple maggot (*Rhagoletis pomonella* Walsh, fig. 42) is a two-winged fly that appears in June and lays its eggs just beneath the skin of apples. The white maggots, upon hatching, burrow throughout the apple in various directions. When full-fed the maggot drops to the ground, under which it pupates and emerges as a fly the next spring.

The cherry fruit-fly (*Rhagoletis cingulata* Loew, fig. 43) infests cherry in much the same manner as the apple maggot infests apples, and has a similar life history.

The plum curculio (*Conotrachelus nenuphar* Herbst.) is a small, grayish weevil that passes the winter under the bark of a tree or among rubbish. In spring it deposits eggs within the plum (peach or cherry) and then cuts a crescentic slit in the skin near by. The larva or grub soon hatches and feeds in the fruit, causing it to ripen

prematurely and fall. The grub, when full-grown, passes into the ground and there pupates, the beetle issuing in the fall. The beetle has a peculiar habit of dropping from the tree when disturbed.

The quince curculio (*Conotrachelus cratægi* Walsh.) is a very similar insect to the plum curculio. It is the cause of knotty or wormy quinces. The weevil lays her eggs in little pits of the quince eaten by the parent for that purpose. The grubs feed in the quince till the early fall, when they leave it and burrow beneath the ground. Here they pass the winter, pupating in early spring.

The pear midge (*Diplosis pyrivora* Riley) is a tiny, two-winged fly much like the Hessian fly, that appears in the spring and lays its eggs in young pears. The larvæ feed near the core, causing the fruit to shrivel and drop. When full-fed they leave the fruit and pupate about an inch or so beneath the surface of the ground. The winter is passed in this condition, and the flies emerge the following spring.

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L. O. HOWARD, Entomologist.

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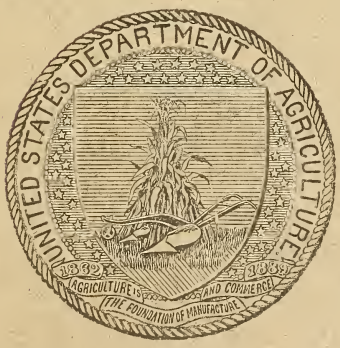
PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST,

BY

NATHAN BANKS,

Assistant Entomologist.



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